Oyster Model Update

Chesapeake Bay simulations

1900-1914

1980-2015

Used as input to oyster model

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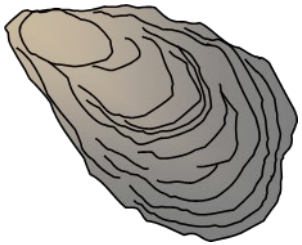
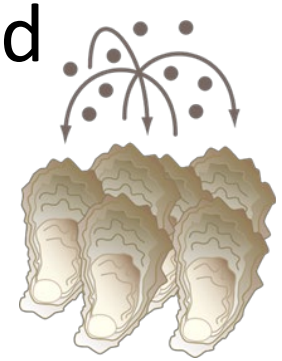


Oyster Model

- Eastern oyster – simulate post-settlement population and Dermo disease infection intensity and prevalence
- Population outputs are total number, population size frequency, reproductive capacity, mortality distribution
- Disease outputs - Dermo prevalence and intensity



Oyster Model Implementation

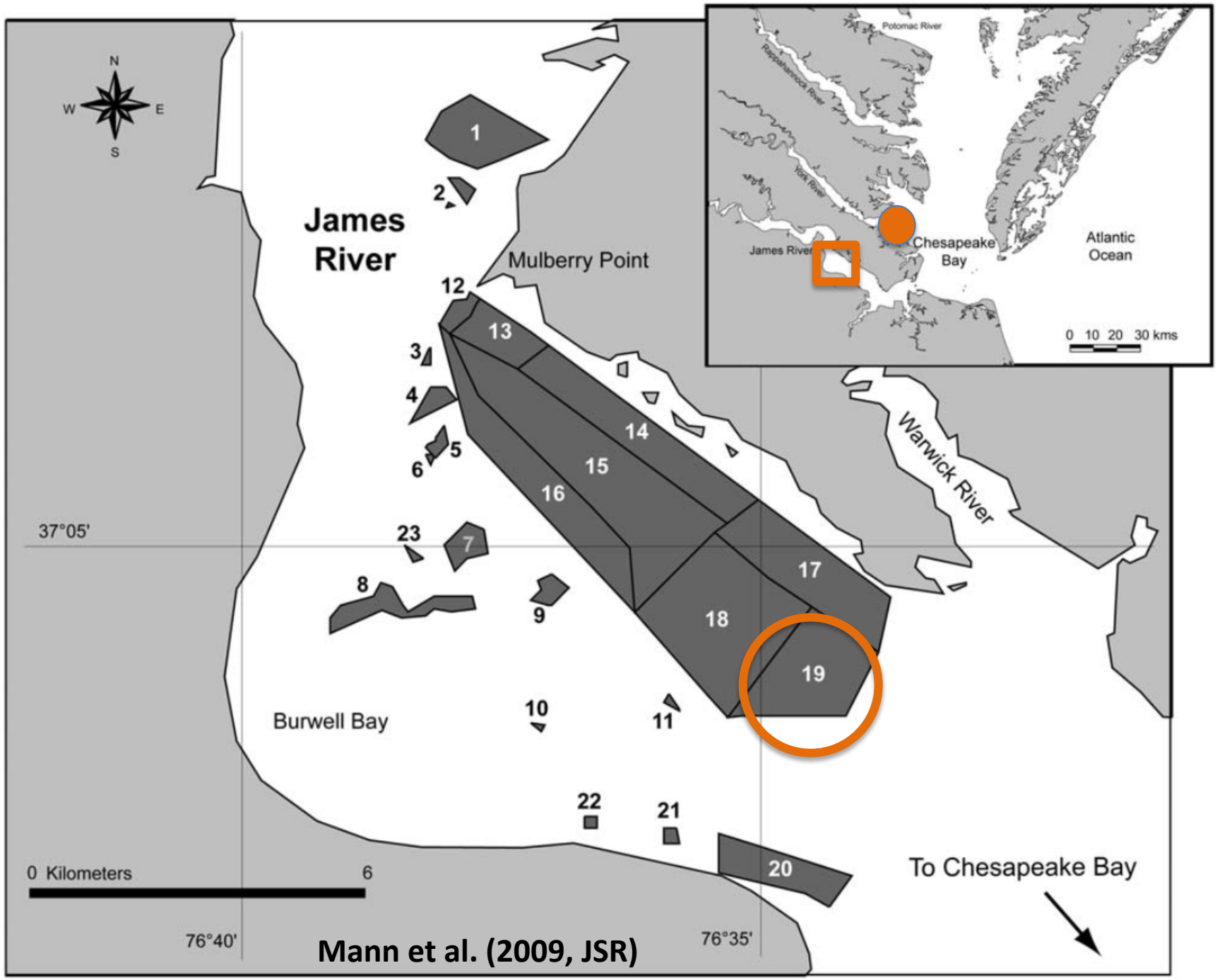
- Inputs are temperature, salinity, food
- Time series obtained from Chesapeake Bay biogeochemical model
    - 1900 -1914
    - 1980 - 2015
- Model applied to southern Chesapeake Bay at locations that have long time series of oyster demographic and dermo disease data
- Applied in time-dependent mode with no recruitment

Oyster Model Results

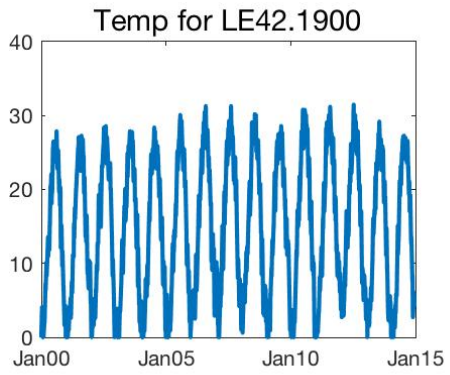
- Results shown as Mackin Index
- Semi-quantitative scale of infection intensity for *Perkinsus marinus*
- Scale goes from 1 to 5, with 1 being a light infection and 5 a heavy infection
- Calculated from weighted prevalence - the infection intensity multiplied by the prevalence
- This gives a measure of the relative severity of *P. marinus* infection in a population

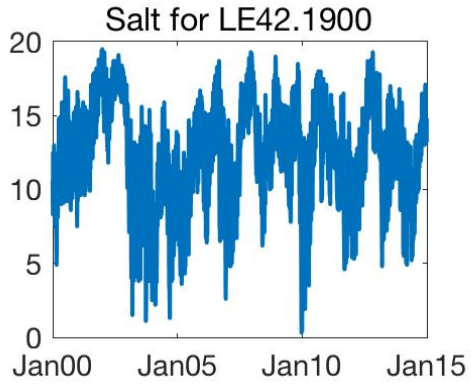
STATION	LATITUDE	LONGITUDE
James River		
Deep Water Shoal	37 08 56	76 38 08
Mulberry Point	37 07 09	76 37 55
Horsehead	37 06 24	76 38 02
Point of Shoal	37 04 37	76 38 36
Swash	37 05 52	76 36 44
Long Shoal	37 04 35	76 37 01
Dry Shoal	37 03 41	76 36 14
Wreck Shoal	37 03 37	76 34 20
Thomas Rock	37 01 32	76 29 33
Nansemond Ridge	36 55 20	76 27 10
York River		
Bell Rock	37 29 05	76 44 58
Aberdeen Rock	37 20 00	76 36 06
Mobjack Bay		
Tow Stake	37 20 18	76 23 28
Pultz Bar	37 20 22	76 23 16
Piankatank River		
Ginney Point	37 32 00	76 24 12
Palace Bar	37 31 36	76 22 12
Burton Point	37 30 54	76 19 42
Rappahannock River		
Ross Rock	37 54 04	76 47 21
Bowler's Rock	37 49 35	76 44 08
Long Rock	37 48 59	76 42 50
Morattico Bar	37 46 55	76 39 33
Smokey Point	37 43 07	76 34 48
Hog House	37 38 30	76 33 04
Middle Ground	37 41 00	76 28 24
Drumming Ground	37 38 38	76 27 59
Parrot Rock	37 36 21	76 25 20
Broad Creek	37 34 37	76 18 03
Great Wicomico River		
Haynie Point	37 49 47	76 18 33
Whaley's East	37 48 31	76 18 00
Fleet Point	37 48 35	76 17 19

Plus Tangier Sound

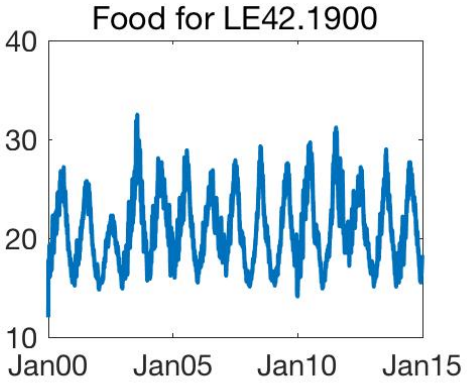


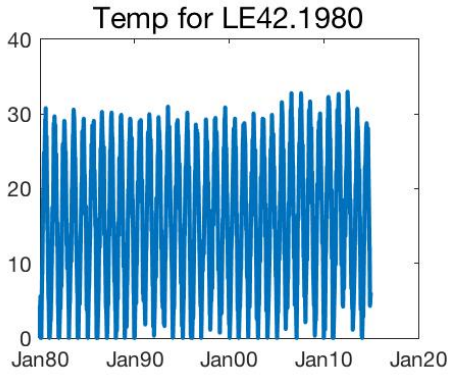
Mann et al. (2009, JSR)

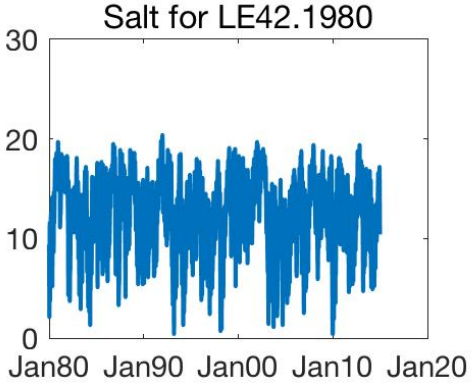

Temp for LE42.1900
40
30
20
10
0
Jan00
Jan05
Jan10
Jan15

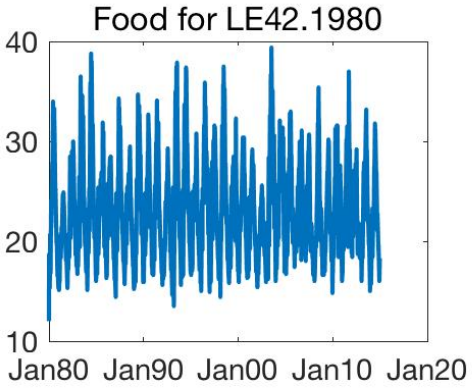

Salt for LE42.1900
20
15
10
5
0
Jan00
Jan05
Jan10
Jan15

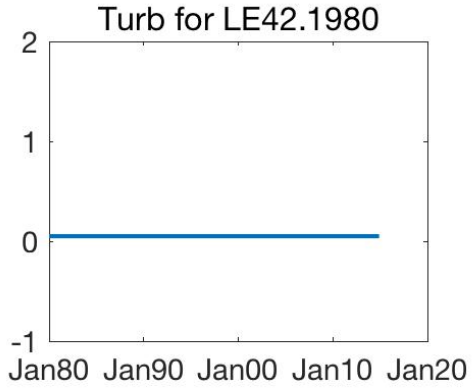
York River

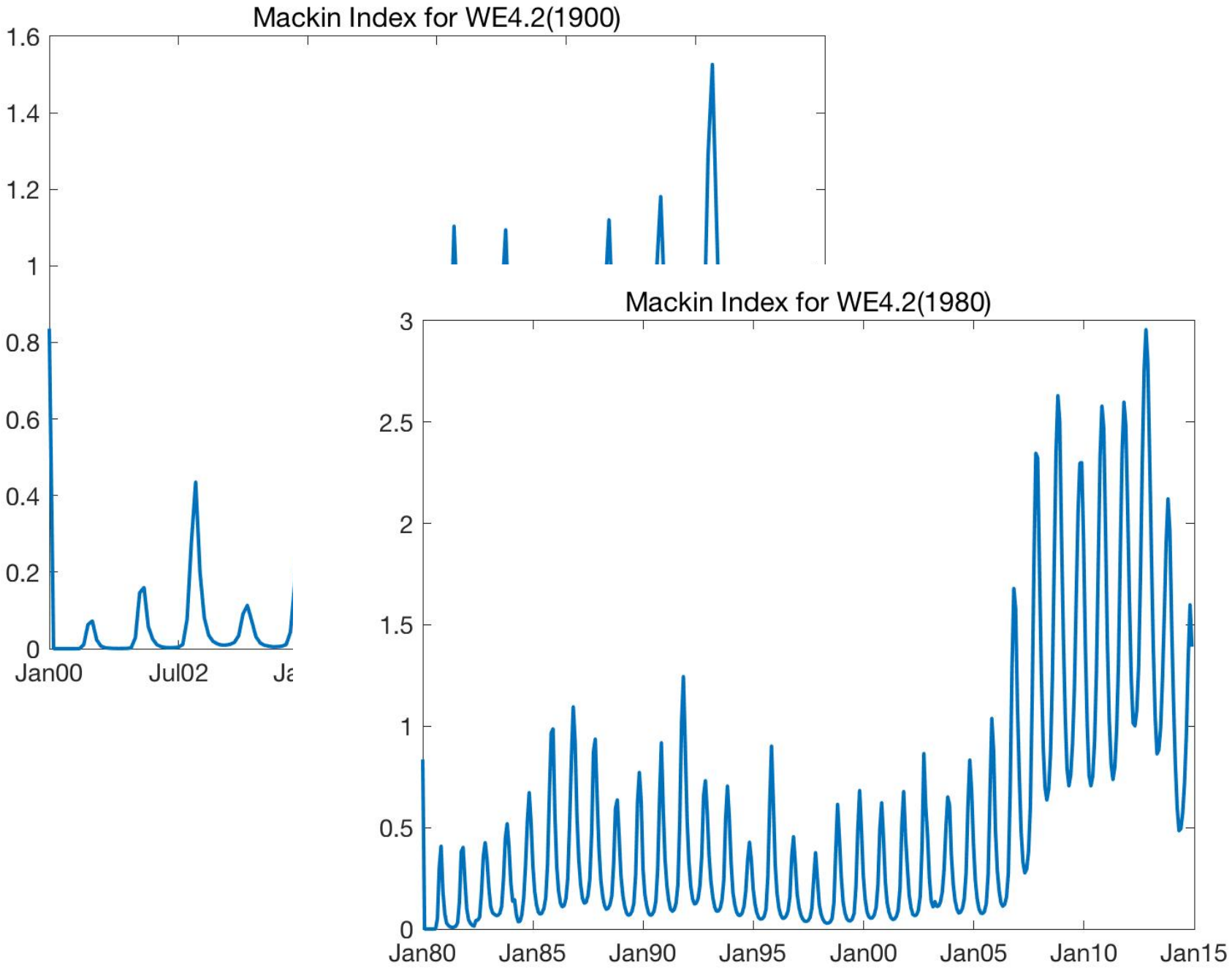

Food for LE42.1900
40
30
20
10
Jan00
Jan05
Jan10
Jan15

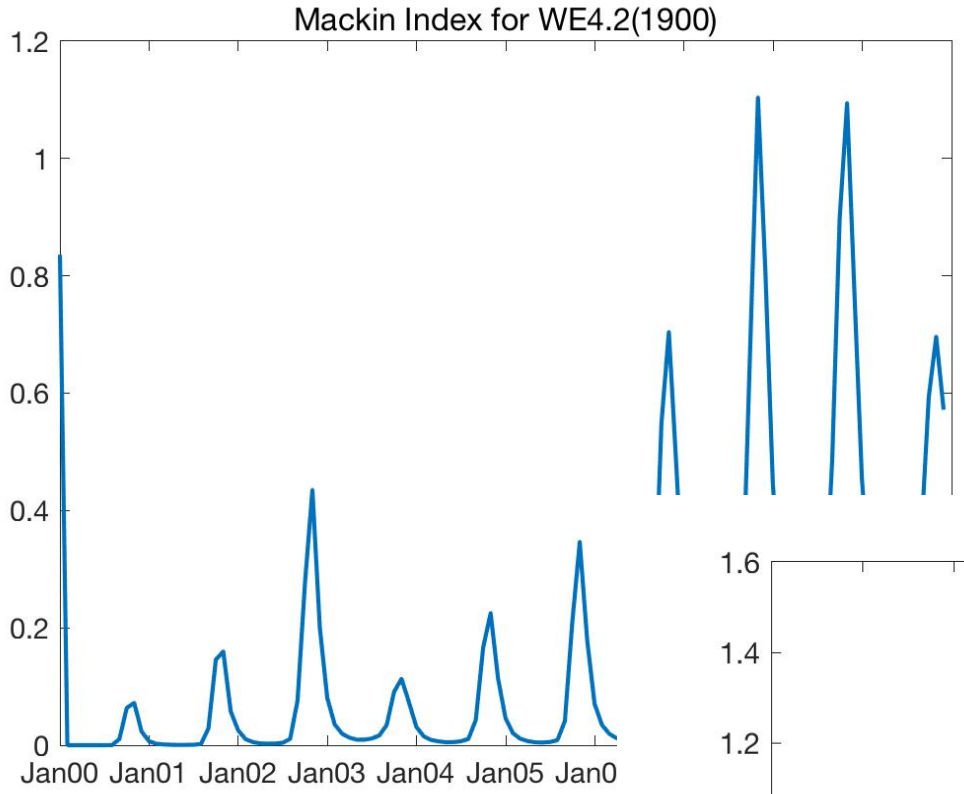

Temp for LE42.1980
40
30
20
10
0
Jan80
Jan90
Jan00
Jan10
Jan20

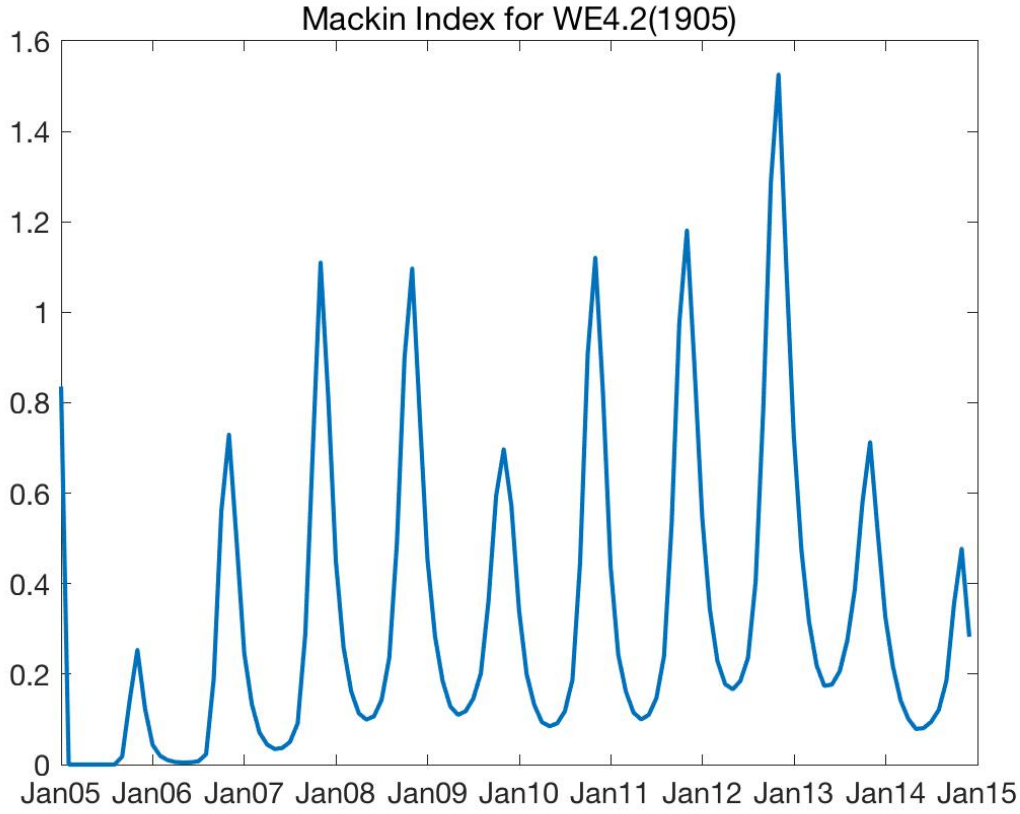

Salt for LE42.1980
30
20
10
0
Jan80
Jan90
Jan00
Jan10
Jan20

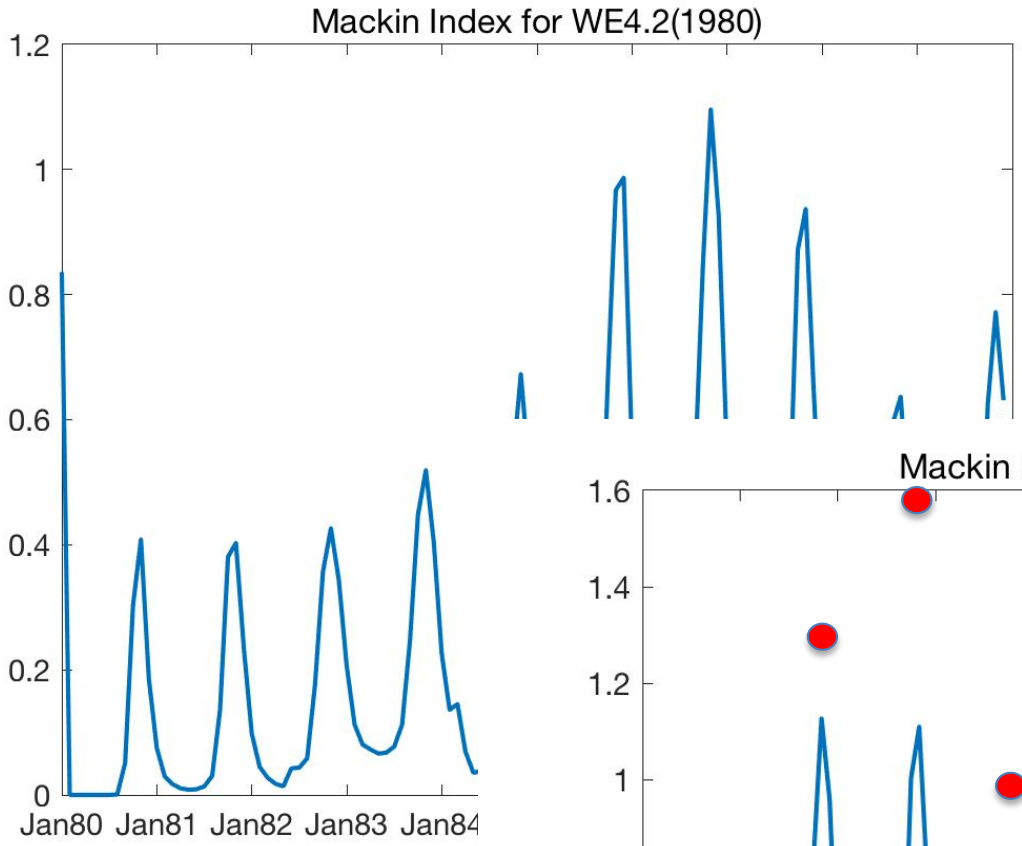

Food for LE42.1980
40
30
20
10
Jan80
Jan90
Jan00
Jan10
Jan20

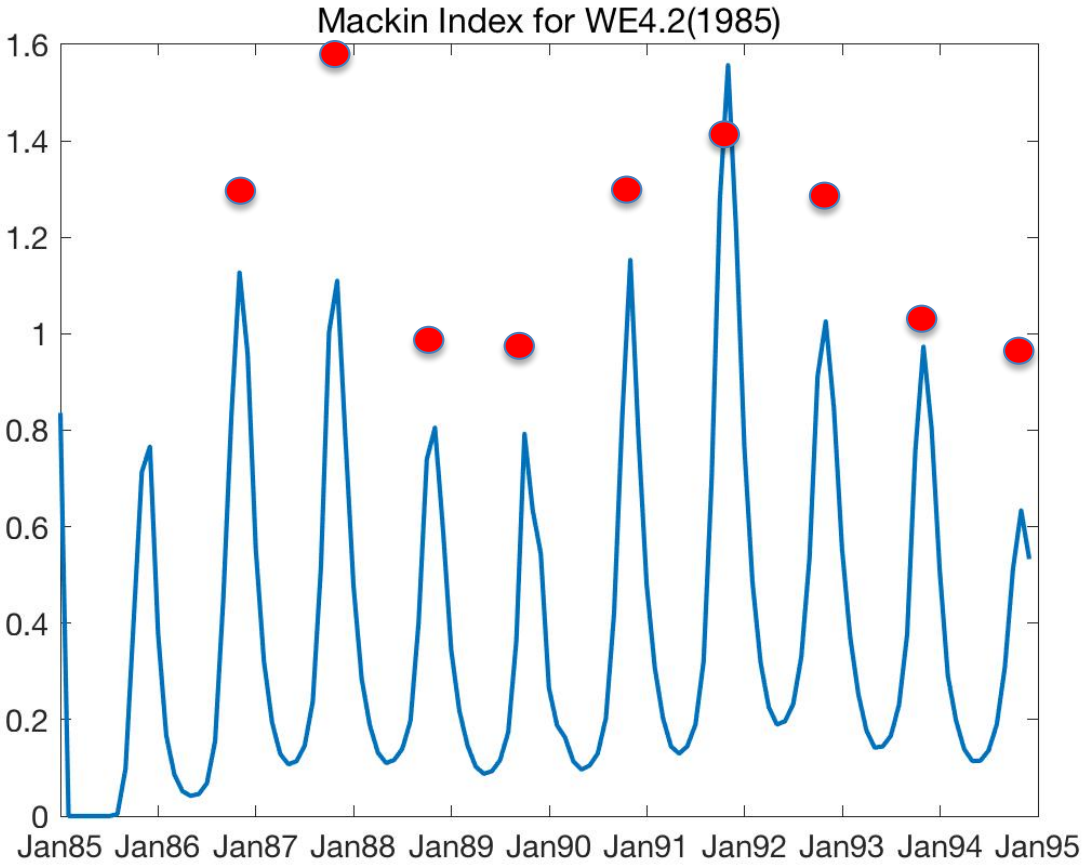

Turb for LE42.1980
2
1
0
-1
Jan80
Jan90
Jan00
Jan10
Jan20


Mackin Index for WE4.2(1900)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan00
Jul02
Ja
Mackin Index for WE4.2(1980)
3
2.5
2
1.5
1
0.5
0
Jan80
Jan85
Jan90
Jan95
Jan00
Jan05
Jan10
Jan15

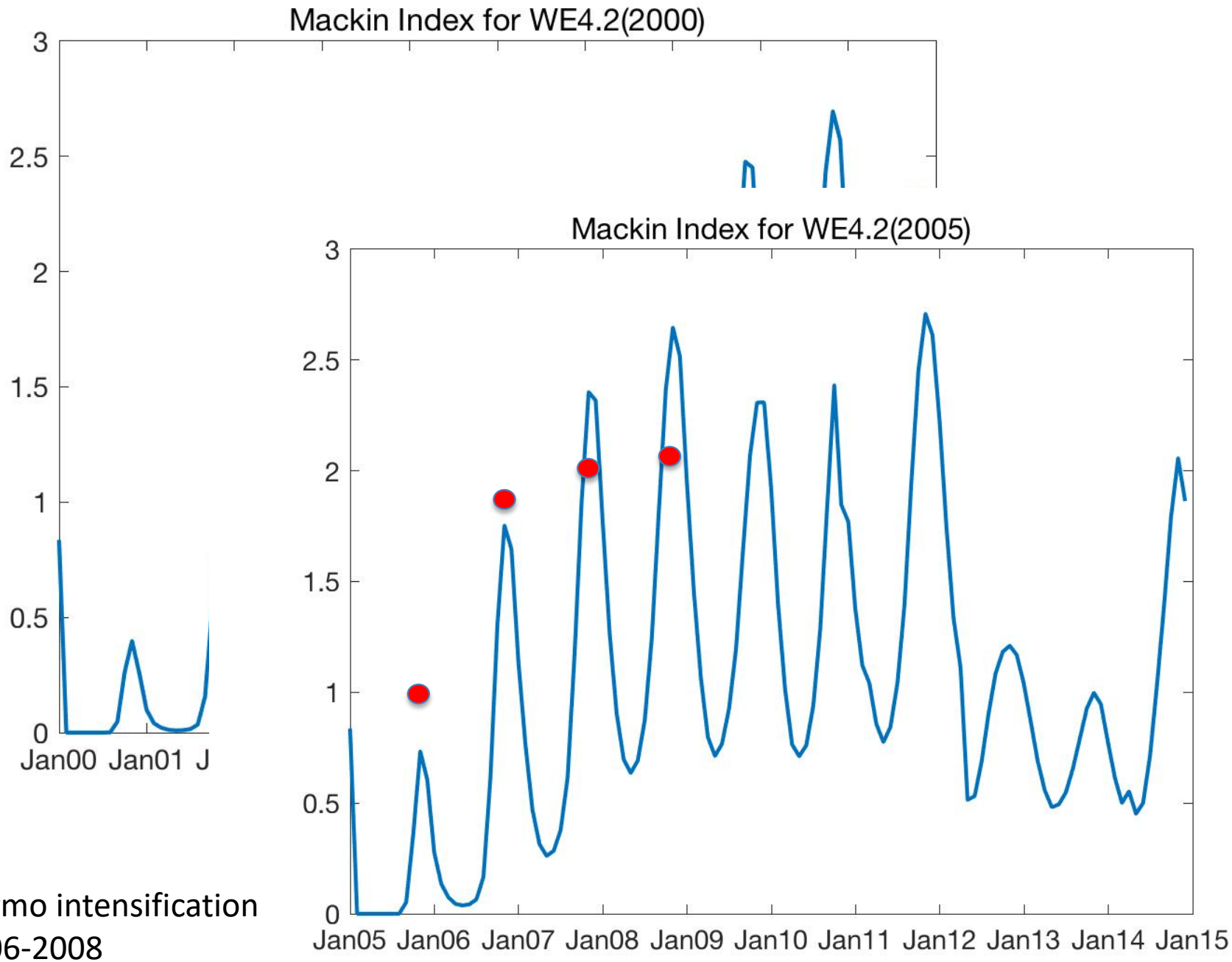

Mackin Index for WE4.2(1900)
1.2
1
0.8
0.6
0.4
0.2
0
Jan00 Jan01 Jan02 Jan03 Jan04 Jan05 Jan0


Mackin Index for WE4.2(1905)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan05 Jan06 Jan07 Jan08 Jan09 Jan10 Jan11 Jan12 Jan13 Jan14 Jan15

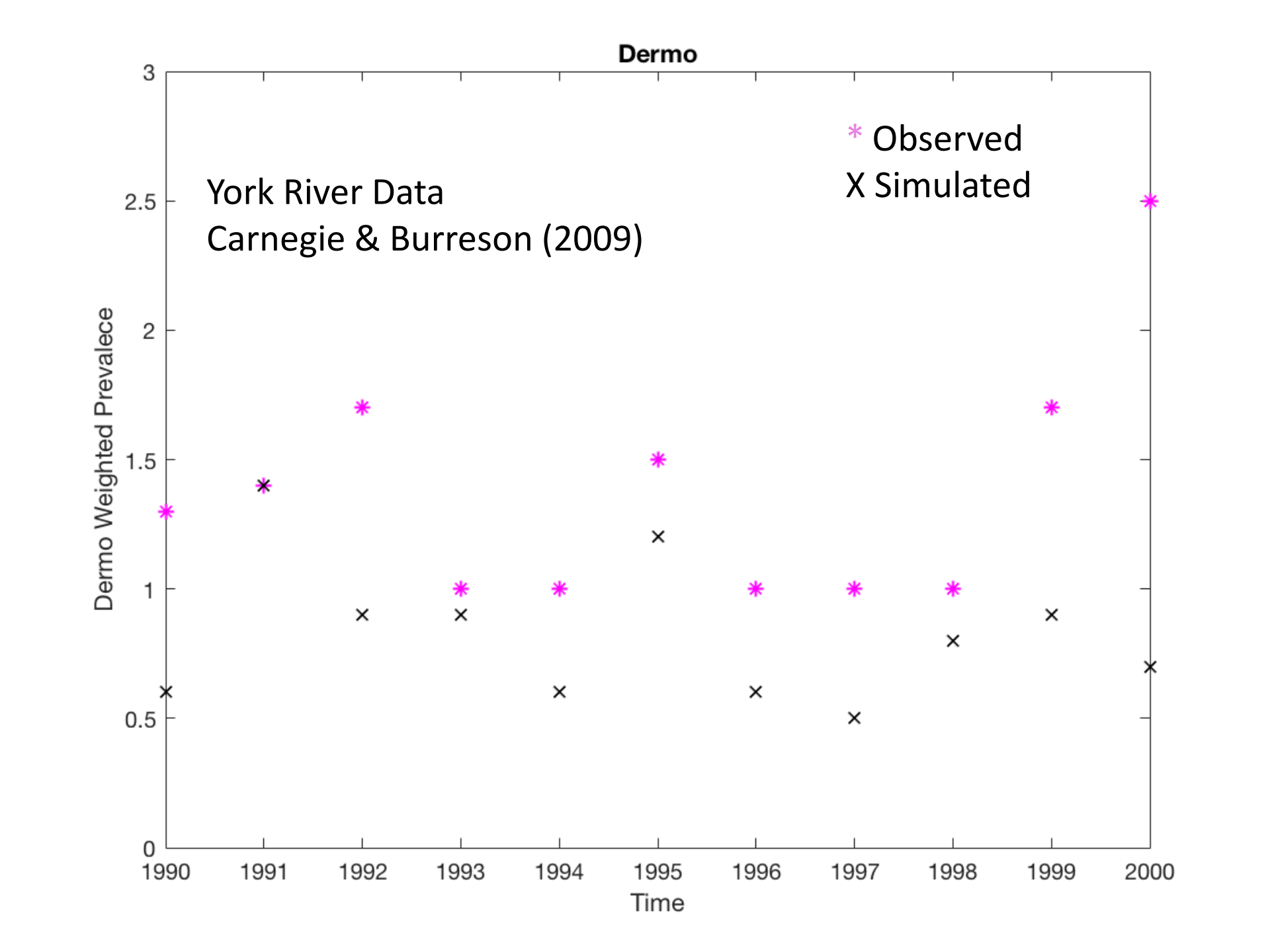


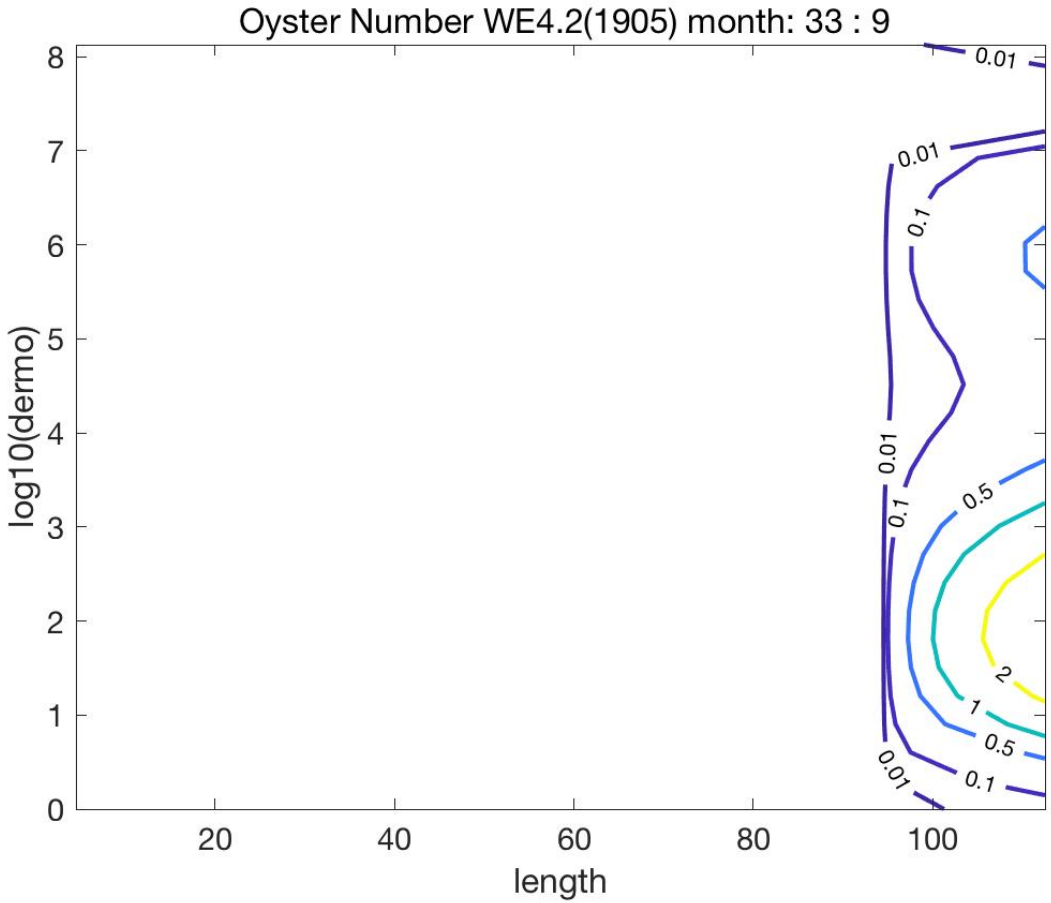


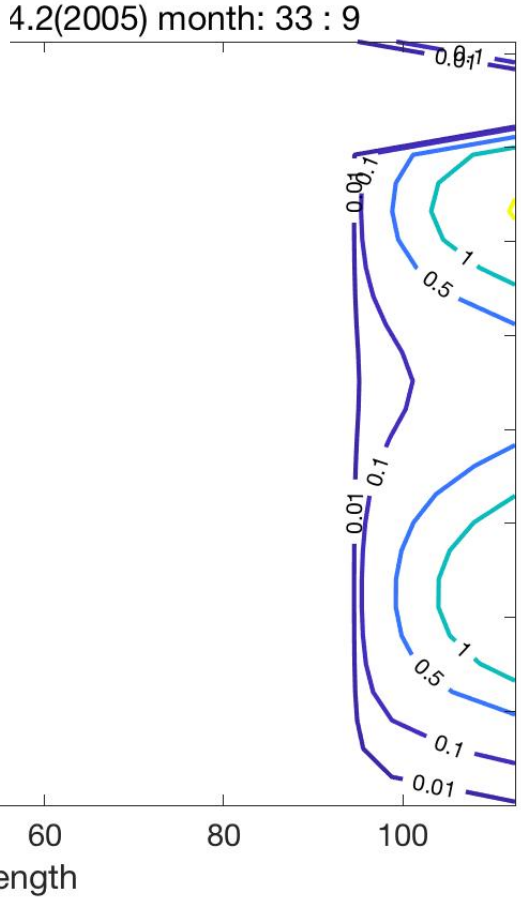
Dermo intensification
In 1986-87 & 1990-1992
Carnegie & Burreson (2009)



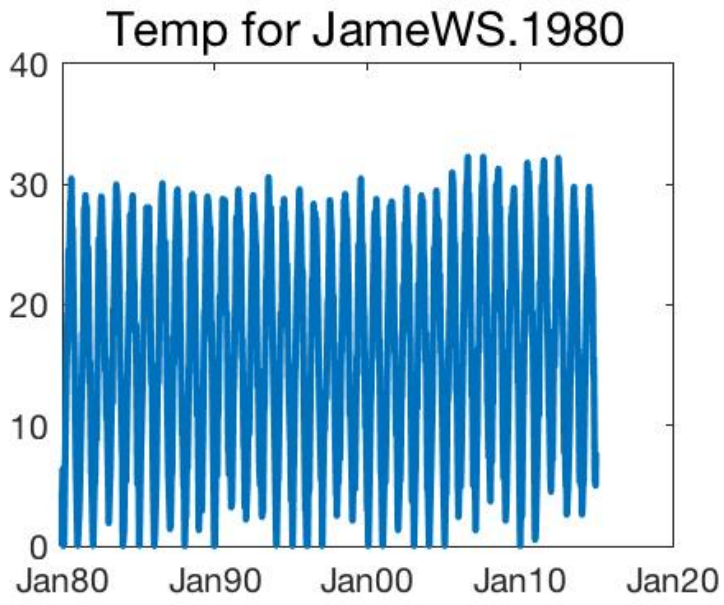
Dermo intensification
2006-2008
Carnegie & Burreson (2009)

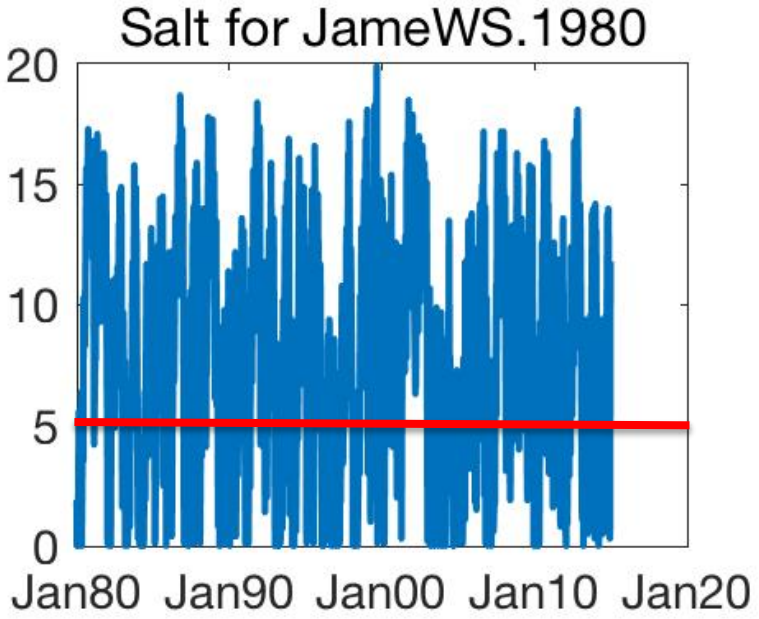

Dermo
Observed
Simulated
York River Data
Carnegie & Burreson (2009)
Dermo Weighted Prevalence
Time
0
0.5
1
1.5
2
2.5
3
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

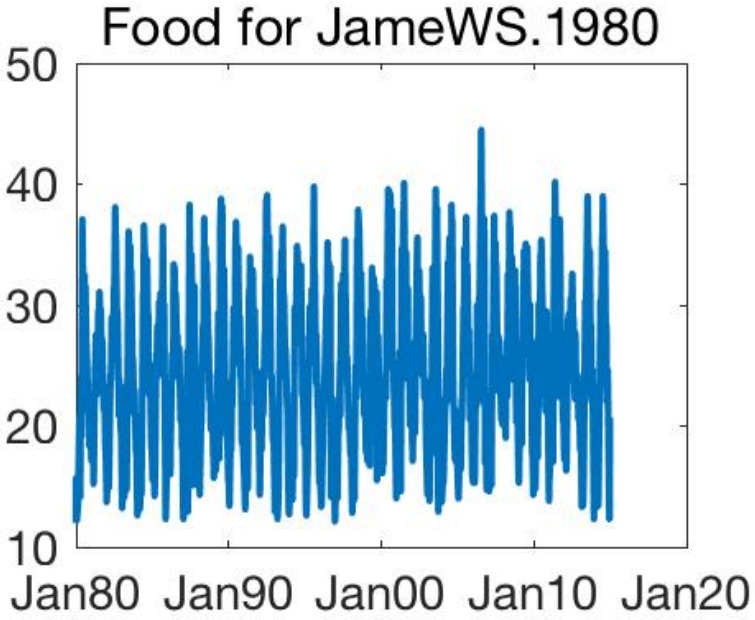


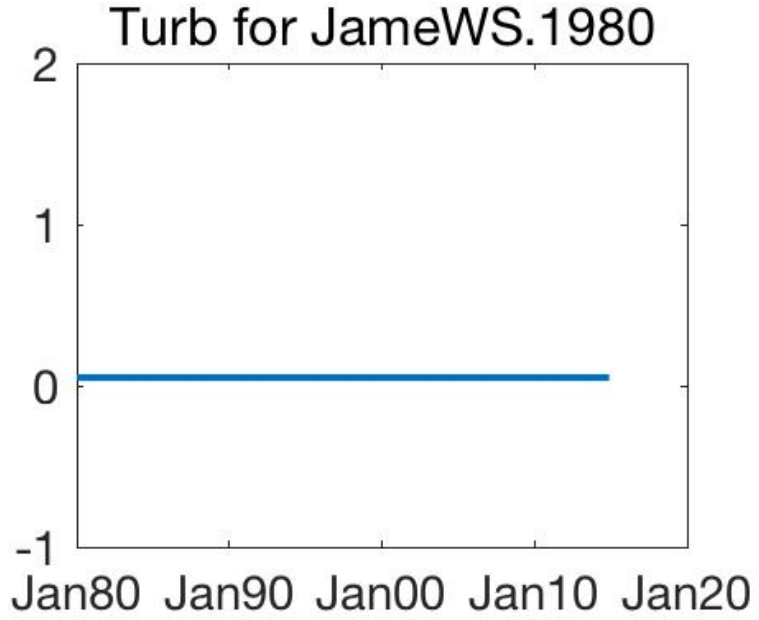


More oysters at
higher body burden


Temp for JameWS.1980
40
30
20
10
0
Jan80
Jan90
Jan00
Jan10
Jan20

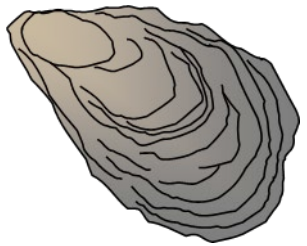

Salt for JameWS.1980
20
15
10
5
0
Jan80
Jan90
Jan00
Jan10
Jan20


Food for JameWS.1980
50
40
30
20
10
Jan80
Jan90
Jan00
Jan10
Jan20


Turb for JameWS.1980
2
1
0
-1
Jan80
Jan90
Jan00
Jan10
Jan20

Summary

- Effect of environmental conditions
  - Higher temperature released pathogen
  - Higher food allows oyster to exist with higher pathogen load
  - Trade offs between temp, food & salinity



Next?

- Adding other metrics for looking at model output – growth and mortality rates – compared to oyster survey data
- Simulations that include a range of oyster densities
- Historical data on size frequency distributions and growth rates for James River
- Analysis of environmental conditions